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V. *Further Experiments on Substances resisting Putrefaction; with Experiments upon the Means of hastening and promoting it; by John Pringle M. D. F. R. S.*

Read Nov. 15, 1750. **H**AVING given a particular Account of the Manner of trying Antiseptics on the fibrous Parts of Animals *, I shall only mention the Result of some Experiments made with them upon the Humours.

1. Decoctions of Wormwood and of the Bark, also Infusions of Chamomile-flowers, and of Snake-root preserved Yolks of Eggs, not only several Days longer than Water did alone, but also when a good Quantity of Sea-Salt was added to it. I likewise found that Salt of Hartshorn preserved this Substance better than four times its Weight of Sea-Salt.

2. Ox's Gall was kept some time from Putrefaction by small Quantities of Lye of Tartar, Spirit of Hartshorn, crude *Sal Ammoniac*, and the saline Mixture, and still longer by a Decoction of Wormwood, Infusions of Camomile-flowers, and of Snake-root; by Solutions of Myrrh, Camphire, and Salt of Amber: All were separately mixed with Gall, and found more antiseptic than Sea-Salt; and seemingly in proportion to their Effects upon Flesh. Only Nitre failed; which, tho' four times stronger than Sea-Salt in keeping Flesh sweet, is inferior to it in preserving Gall; and remarkably weaker than crude *Sal Ammoniac*; which again is somewhat less powerful than

* See this *Transaction*, p. 525, &c.

than Nitre in preserving Flesh. The Nitre was soon opened by the Gall, and emitted a vast Quantity of Air, which rose as from a fermenting Liquor; and when this happened, the Gall began to putrefy. But the saline Mixture generated no Air, and opposed the Putrefaction of Gall more than it did that of Flesh.

3. The last Trial was with the *Serum* of human Blood, which was preserved by a Decoction of the Bark, and an Infusion of Snake-root, nor with less Efficacy than Flesh. But Saffron and Camphire were not here above a fourth Part so antiseptic as before; whether it be that they are less preservative of this Humour, or, as I suspect, that they were not well mixed. Nitre acted nearly with its full Force, being about four times stronger than Sea-Salt: It generated some Air, but much less than it did with the Gall. No other Humour was tried; but, from these Specimens added to the former Experiments, we may conclude, that whatever is preservative of Flesh will be generally antiseptic, tho' perhaps not always with equal Force.

4. Having already shewn how putrid Flesh might be sweetened, I shall conclude this Part of my Subject with a like Trial upon the Yolk of an Egg. A Portion of this, being diluted with Water, stood till it corrupted; when a few Drops were put into a Phial with two Ounces of pure Water, and about twice as many Drops were mixed with a strong Infusion of Camomile-flowers. At first both Phials had some Degree of a putrid Smell; but being corked, and kept a few Days near a Fire, the Mixture, with
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plain Water contracted a strong *Fætor*, whilst the other smelled only of the Flowers.

Thus far have I related the Experiments made of Antiseptics; by which it appears, that, besides Spirits, Acids, and Salts, we are possessed of many powerful Resisters of Putrefaction, endued with Qualities of heating, cooling, Volatility, Astringion, and the like, which make some more adapted than others to particular Indications. In some putrid Cases, many proper Antiseptics are already known; in others they are wanting. We are yet at a Loss how to correct the *Sanies* of a cancerous Ulcer; but, from such a Multitude of Antiseptics, it is to be hoped some may be found at last adequate to that Intention. It may be farther remarked, that, as different Distempers of the putrid kind require different Antiseptics, so the same Disease will not always yield to the same Medicine. Thus the Bark will fail in a Gangrene, if the Vessels are too full, or the Blood sily: But, if the Vessels are relaxed, and the Blood resolved or disposed to Putrefaction, either from a bad Habit, or the Absorption of putrid Matter, then is the Bark a good Specific. With the same Caution are we to use it in Wounds; *viz.* chiefly in Cases of absorbed Matter, which infects the Humours, and induces a hectic Fever. But, when inflammatory Symptoms prevail, the same Medicine increasing the Tension of the Fibres, and Sickness of the Blood, a State directly opposed to the other, has such Consequences as might be expected.

By the Success of the Bark in so many putrid Cases, it should appear that Astringion had no small Share in the Cure. And indeed the very Nature of
Putrefaction

Putrefaction consists in a Separation or Disunion of the Parts. But as there are other Cases, in which Astringency is less wanted, we may find in Contrayerva-root, Snake-root, Camphire, and other Substances, a highly antiseptic Power, with little or none of the other Quality. And since several of these Medicines are also diaphoretic, their Operation is thereby render'd more successful.

I come now to the last thing proposed, which was, to give an Account of some Observations made on Substances hastening or promoting Putrefaction; an Inquiry not less useful than the former. For, setting aside the offensive Idea commonly annexed to the Word, we must acknowledge Putrefaction to be one of the Instruments of Nature, by which many great and curious Changes are brought about. With regard to Medicine, we know, that neither animal nor vegetable Substances can become Aliment, without undergoing some Degree of Putrefaction. Many Distempers proceed from a Deficiency of this Action. The *Crisis* of Fevers seem to depend upon it; and perhaps even animal Heat, according to a late ingenious Theory *.

But, in the Prosecution of this Subject, I have met with very few real Septics; and found many Substances, commonly accounted such, of a quite opposite Nature. The most general means of accelerating Putrefaction is, by Heat, Moisture, and stagnating Air; which being sufficiently known and ascertained, I
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* An Essay on the Cause of animal Heat, by J. Stevenson, M.D. *Vide* Medical Essays, Vol. V.

passed over, without making any particular Experiment on those Heads. Lord *Bacon* *, as well as some of the Chemists, has hinted at a putrid Fermentation, analogous to what is found in Vegetables; and this having so near a Connexion with Contagion, I made the following Experiment, for a further Illustration of this Matter.

5. In the Yolk of an Egg, already putrid, a small Thread was dipped, and a small Bit of this was cut off and put into a Phial, with Half of the Yolk of a new-laid Egg diluted with Water. The other Half, with as much Water, was put into another Phial, and both being corked, were set by the Fire to putrefy. The Result was, that the Thread infected the fresh Yolk; for the Putrefaction was sooner perceived in the Phial that contained it, than in the other. But this Experiment was not repeated.

In this manner the Putrefaction of Meat advances quicker in a confined than a free Air; for, as the most putrid Parts are also the most fugitive; they incessantly issue from a corruptible Substance, and disperse with the Wind; but in a Stagnation of Air, they remain about the Body; and by way of Ferment excite it to Corruption.

6. As for other Septics, recited by Authors, I found none of them answer the Purpose. The alkaline Salts have been consider'd as the chief Putrefiers. But this is disproved by Experiments. Of the Volatiles it may be indeed observed, that, tho' they preserve from the common Marks of Putrefaction, with

* Vide *Nat. Hist.* Cent. IV. Exper. 330.

with a Force four times greater than that of Sea Salt; yet, in warm Infusions, a small Quantity of these Salts will soften and resolve the Fibres, more than Water does by itself. They also hinder the Coagulation of Blood; and when taken by way of Medicine, thin and resolve it, but are not therefore Septics. For, so little do these Salts putrefy, or even resolve the Fibres, when applied dry, that I have kept, since the Beginning of *June* last, notwithstanding the excessive Heats, a small Piece of Flesh in a Phial, preserved only with Salt of Hartshorn, at present perfectly sound, and firmer than when first salted.

7. From the Specimens we had of the antiscorbutic Plants, it is likewise probable none of that Tribe will prove septic. Horse-radish, one of the most acrid, is a very powerful Antiseptic. And tho' Carrots, Turneps, Garlick, Onions, Celery, Cabbage, and Colewort, were tried (as Alcalescents) they did not hasten, but somewhat retarded, the Putrefaction.

8. The Case was different with such farinaceous Vegetables as were examined; *viz.* white Bread in Infusion, Decoctions of Flour, Barley, and Oatmeal; for these did not at all retard Putrefaction; but, after it was somewhat advanced, they check'd it, by turning sour. By a long Digestion the Acidity became considerable; which, by conquering the Putrescency of the Flesh, and generating much Air, did not ill represent the State of weak Bowels, which convert Bread, and the mildest Grains, to such an Acid, as prevents a due Resolution and Digestion of animal Food*.

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* It is to be remarked, that, in making this Experiment, I did not then attend to a Fermentation that ensued, and which was the Cause

9. I examined *Cantharides*, dried Vipers, and *Russian Castor*, all animal Substances, and therefore most likely to prove septic. The Flies were tried both with fresh Beef, and with the *Serum* of human Blood; the Vipers only with the former; but neither of them hastened Putrefaction. And as for the *Castor*, so far from promoting this Process, that an Infusion of 12 Grains opposed it more than the standard Salt.

10. After finding no Septics where they were most expected, I discovered some which seemed the least likely; *viz.* Chalk, the *Testacea*, and common Salt.

Twenty Grains of Crabs-eyes prepared, were mixed with 6 Drachms of Ox's Gall, and as much Water; into another Phial was put nothing but Gall and Water, in the same Quantity with the former; and both being placed in the Furnace, the Putrefaction began much sooner, where the Powder was, than in the other Phial. I infused afterwards in the Lamp-Furnace 30 Grains of prepared Chalk, with the usual Quantity of Flesh and Water; and observed that the Corruption not only began sooner, but went higher by this Mixture; nay, what had never happened before, that in a few Days the Flesh resolved into a perfect *Mucus*. The Experiment was repeated with the same Effect; which being so extraordinary, I suspected some corrosive Substance had been mixed with the Powder: But, for a Trial, a Lump
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Cause of the Acidity. This kind of Fermentation between animal and vegetable Substances, being hitherto overlooked, shall be therefore set forth in my next Paper.

of Chalk being pounded, 30 Grains of it proved fully as septic as the former. The same Powder was compared with an equal Quantity of Salt of Wormwood, and Care was taken to shake both the Mixtures alike: But, after three Days warm Digestion, the Salt had neither tainted nor soften'd the Flesh, whilst the Chalk had rotted and consumed that which was joined to it. Nor were the Effects less of the testaceous Powders of the Dispensary. Eggshells in Water resisted Putrefaction, and preserved the Meat longer firm than plain Water*.

11. To try whether the *Testacea* would also dissolve vegetable Substances, I infused them with Barley and Water, and compared this Mixture with another of Barley and Water, without the *Testacea*. After a long Maceration by a Fire; the plain Water swelled the Barley, became mucilaginous and sour; but that with the Powder kept the Grain to its natural Size, tho' it softened it, made no Mucilage, and remained sweet.

12. Nothing could be more unexpected than to find Sea Salt a Hastener of Putrefaction. But the Fact is thus. One Drachm of Salt preserves two Drachms of fresh Beef, in two Ounces of Water, above 30 Hours, uncorrupted, in a Heat equal to that of the human Body; or, what amounts to the same, this Quantity of Salt keeps Flesh about 20 Hours longer sweet, than pure Water; but half a Drachm of Salt does not preserve it above 2 Hours longer. This Experiment has been already mentioned.

* The Trial was made with a coarse Powder, of this Substance, but not repeated.

nioned. Now I have since found, that 25 Grains have little or no antiseptic Virtue; and that 10, or 15, or even 20 Grains manifestly both hasten and heighten the Corruption*. It is moreover to be remarked, that in warm Infusions with these smaller Quantities, the Salt, instead of hardening the Flesh, as it does in a dry Form, in Brine, or even in Solutions, such as our Standard, it here softens and relaxes the Texture of the Meat, more than plain Water; tho' much less than Water with Chalk, or the testaceous Powders.

Many Inferences might be made from this Experiment; but I shall only mention one. Salt, the indispensable Seasoner of animal Food, has been supposed to act by an antiseptic Quality, correcting the too great Tendency of Meats to Putrefaction. But, since it is never taken in Aliment beyond the Proportion of the corrupting Quantities in our Experiment, it would appear that Salt is subservient to Digestion, chiefly by a septic Virtue; that is, by softening and resolving Meats; an Action very different from what is commonly believed.

* The most putrefying Quantity of Salt, with this Proportion of Salt and Water, is about 10 Grains.